COMPARISONS BETWEEN MASS MOVEMENTS ON VENUS ASSOCIATED WITH MODIFIED DOMES AND THOSE FROM ESCARPMENTS; Bulmer MH (Center for Earth & Planetary Studies, NASM, Smithsonian, Washington D.C. 20560. MRC 315. mbulmer@ceps.nasm.edu).

Previous work has focused on identifying geomorphological insights into the nature of the transport and emplacement of debris aprons labeled G1, G2 and G4, associated with modified domes on Venus [1]. These catastrophic slope failures appear to have been gravitationally induced because there is no evidence of volcanic assistance in their emplacement. G1 and G2 categories of mass movement are of particular interest since they show a tendency to have traveled further for a given fall height than those on the other terrestrial planets. Using the results from the morphometric study, the kinematics of movement were examined by considering a block descending an inclined plain and traveling out over a horizontal surface [2]. For the debris aprons to have traveled tens of kilometers requires coefficients of friction to be below 0.05. There is no reason to assume such an inherently low value of the frictional coefficient. Values of frictional resistance over the volcanic plains may range between 0.6 and 0.8 [3].This suggests that another factor must have enhanced the mobility of the debris masses. A comparative study has begun on mass movements that occur independent of volcanic edifices. A preliminary study of such features was conducted by Malin [4].

A range of mass movement morphologies can be identified in settings not associated with the flanks of volcanoes. Aprons which are characterized by steep headscarps, hummocky textures, and lobate distal zones (NV1) are similar to G1 and G2 aprons associated with modified domes, which in turn are similar to rock/debris avalanches on Earth. Examples of large failures (NV2) with broad steep scarps and aprons composed of massive blocks that traveled only short distances are similar to category G4. In plan form the aprons are either blunt with near-parallel lateral and distal margins, or lobate with convex lateral and distal margins. These failures appear to have been translational and rotational in nature. Another category of debris aprons (NV3) have a mottled surface texture and no obvious evidence for the hummocks seen in other aprons. Multiple lobes and fingers can be discerned in the distal regions. The size of these aprons varies considerably. Some occur as streaks at the limit of resolution while others cover areas as large of those of NV1 aprons. It has been suggested that NV3 aprons may be debris flows [4]. The textural characteristics of the aprons indicate that they may be granular flows derived from poorly consolidated material that required no interstitial medium. At least one apron with shared characteristics possibly resulting from flow has been identified on a modified dome situated in eastern Mokosha Mons (55 N, 266 E).

Slope failures not associated with the flanks of volcanoes occur in a range of geomorphic settings which include chasmata, montes, and tesserae terrain. Aprons in categories NV1and NV2 occur most commonly on ridges and along the scarps of topographic highs. Often more than one apron can be identified at the base of slopes in such settings. This indicates that there may have been contemporaneous failures associated with some destabilizing event such as a seismic shock, and/or that failure has been an on-going process. The deposits seem to be the youngest event in many locations. Malin [4] noted that a radar dark apparently smooth material was often associated with these deposits. In some locations this darker material embays the hummocky material in an apron, and in other areas the aprons appears superimposed on the darker material. Such an association is not noted on the debris aprons associated with the modified domes. The origin of this darker material remain enigmatic. Debris aprons in category NV3 occur most frequently on the scarps of chasma and graben. Numerous narrow debris chutes can be identified and aprons of material occur on the floors. In some of these settings NV1 and NV2 aprons also occur. Category NV3 aprons are the most common morphology found and may represent a continual cascade of poorly consolidated material from these slopes. Malin [4] noted a paucity of evidence for mass movements in the highland regions. Detailed observations of

stereo data for Maxwell Montes shows that many slopes have narrow debris chutes of the type NV3.

The travel distances and fall heights of the mass movements not associated with volcanoes NV1, 2, 3, have been compared with those for G1, 2 and 4 (figure 1). Category NV1 aprons have run out distances 10 to 30 km. The travel distances of NV2 tend to be around 10 km and less. Most NV3 aprons traveled less than 10 km but some may have traveled as far as 50 km. The maximum fall height of aprons in NV1, 2 and 3 are greater than those for aprons associated with domes but none have been found that traveled the distances of some G1 and G2 aprons. This raises the question as to why did NV1 and 2 aprons not travel as far. Comparison of the volumes of material involved cannot easily be made using the Magellan data but first order estimates will be made by determining the area of a failed sector. Attempts will also be made to derive thickness values. A significant characteristic of mass movements is that the coefficient of friction decreases with increasing volume.

The results from this study of NV1, 2 and 3 aprons will test the hypothesis that some factor enhanced the mobility of G1 and G2 aprons. since it is reasonable to expect that such a process would operate globally.

References;[1] Bulmer and Guest (1996) in Volcano Instability, edited by McGuire, W.J., A.P. Jones and J. Neuberg, Spec. Pub. Geol. Soc. Lond., 349-371. [2] Bulmer in prep. [3] Byerlee (1978) Pure Applied Geophysics, V. 116, p. 615-626. [4] Malin (1992) J. Geophys. Res., 16,337-16,352.

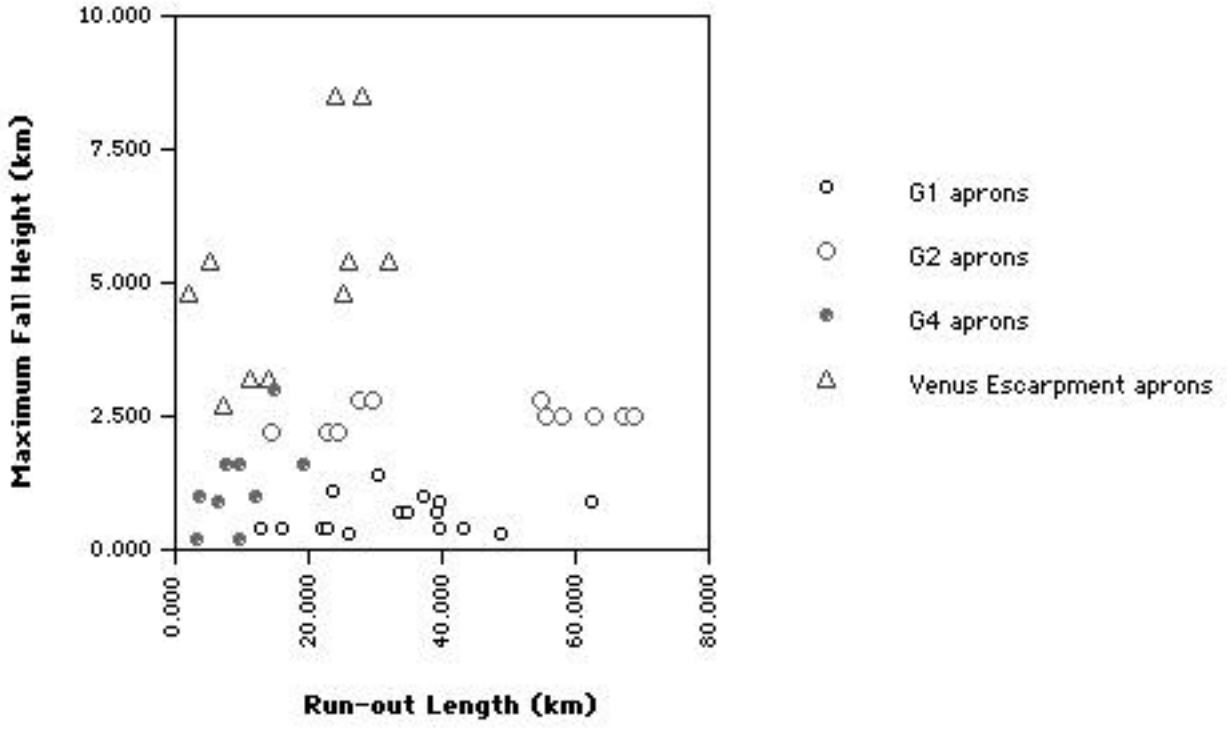

Figure 1.